Airborne Electrical Conductivity Mapping and Monitoring in Areas of Energy Production

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Airborne electromagnetic (AEM) methods have been applied to mapping subsurface electrical conductivity anomalies due to anomalously high salinity in oil and gas fields since the late 1980s. Assessment of possible impacts on shallow groundwater from oil and gas exploration and production methods is difficult due to lack of shallow subsurface information in most energy plays. Many of the impacts can be attributed to various aspects of handling of produced waters that contain high total dissolved solids (TDS) usually due to high salinity. Documented causes of high TDS reaching shallow aquifers can be attributed to spills and leaks from water transportation (pipelines and truck), storage (pits and tanks), disposal (injection wells, brine pits, reserve pits, and infiltration ponds), and production-well integrity (over-pressurization, well-casing corrosion). These causes of shallow groundwater contamination from development of traditional energy resources are present in development of non-traditional energy resources. AEM surveys have been used to identify point and non-point sources of high salinity in Oklahoma oil fields as a follow-up of regional stream salinity surveys. Water management practices in the development of coal bed natural gas in Wyoming have been aided by AEM studies of both disposal and utilization of water. AEM methods have been used in the East Poplar Oil field, northeastern Montana, to map plumes and ground EM methods have been used to supplement monitoring of remediation work. A critical aspect of development of energy resources by deep hydraulic fracturing is impact on water availability, an issue AEM methods have been effectively applied to. AEM methods have an attractive application in establishing baselines because they can be used to rapidly map large areas to depths of at least 100s of meters without surface impacts (important in areas having fragile ecosystems) and without access issues in difficult terrain.